REMARKS

To summarize, Claims 1-3, 5-12 and 14-20 are pending, with Claims 1-18 previously rejected and Claims 19 and 20 being new. No new matter has been entered. Based on the following remarks, it is believed that all pending claims are in condition for allowance and a notice to that affect is respectfully requested.

I. Summary of Claim Rejections

The independent Claims are 1, 6, 10 and 15.

Claims 6-8 and 15-17 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,646,639 to Greene. Dependent Claims 9 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Greene in view of U.S. Patent No. 6,099,573 to Xavier.

Claims 1-5 and 10-14 were rejected under 35 U.S.C. §103(a) as being unpatentable over Greene in view of US Pub. 2003/0122819 to Koneru.

II. Summary of Examiner Interview with respect to independent Claims 6 and 15

A telephonic interview was conducted between Applicant's representative Steven Thiel and Examiner Hajnik on 30 January 2007.

With respect to independent Claims 6 and 15, it was discussed whether Greene discloses the "testing [of] edge information from each object against a sample point in each rectangular area", wherein "the step of testing edge information includes the step of shifting the edge information by a predetermined amount in dependence on the orientation of each edge".

After discussion, both parties agreed that Greene does not disclose the above features, but instead discloses a shifting of plane and edge equations from one coordinate frame to another coordinate frame. Specifically, discussion focused on the disclosure of Greene, which first describes how a

planar equation is evaluated for what is referred to as the standard coordinate frame of figure 10, which is the basic X and Y axis of the display. (See Greene, 25:61-65) The disclosure of Greene then goes on to emphasize how the same planar equation can be computed relative to the coordinate frame (X, Y) of a tile, which is defined as a smaller area of the display. Thus, the shifting referred to in Greene is in fact the modification of the A, B and C components of the plane equation in the standard coordinate frame of figure 10 to obtain the coordinates A', B' and C' as will be required to produce the same plane in relation to the coordinate frame of a tile or subregion (i.e., item 210 of figure 2). This shifting of Greene is then further applied to subregions of a tile, with Greene emphasizing that the "objective is to transform a linear equation of x and y from the coordinate frame of an NxN tile to the coordinate frame of a cell (xt, yt) within it". For further discussion, see the Informal Communication provided to the Examiner on 30 January 2007.

Accordingly, the effect of the process disclosed in Greene is not to shift the edge information in dependence on the orientation of each edge, but instead to shift the coordinate system in relation to which plane and edge is computed. <u>As such, the overall distinction is that it is the coordinate frame which is actually being shifted in Greene, not the plane or edge information.</u>

Examiner Hajnik subsequently requested that the claim language be revised to more clearly indicate how the edge information is being shifted. After review, the Examiner suggested amending Claims 6 and 15 to indicate that the edge information is shifted relative to a fixed or consistent sample point. The Examiner indicated such language would distinguish over Greene, which processes graphics by utilizing a defined fixed edge and variable sampling or test points, while the present invention utilizes a uniform test point with variable edges.

In response, independent Claims 6 and 15 have been amended to call for the "testing [of] edge information from each object against a <u>consistent</u> sample point in each rectangular area".

Although not discussed during the interview, it is also noted that the reference of Xavier was simply cited to supplement a deficiency in Greene with respect to dependent Claims 9 and 18, and that Xavier also does not disclose the unique features discussed above.

Accordingly, it is believed that independent Claims 6 and 15, along with those claims dependent therefrom, are allowable over the references of Greene and Xavier, considered individually or in combination.

III. <u>Summary of Examiner Interview with respect to independent Claims 1 and 10</u>

With respect to Claims 1 and 10, it was discussed during the interview how the claims are directed to a method and apparatus, respectively, for determining whether or not an object is large enough to be considered sufficiently important so as to contribute to the computer graphics image. Applicant's representative subsequently emphasized that the claimed invention achieves this by determining a sampling points for an object from maximum and minimum X and Y values for that object, and by using this process with small objects, objects which do not contribute to the final image can be culled, thereby reducing processing time. Neither Greene nor Koneru disclose this feature.

The Examiner expressed the opinion that the general claim language of "determining maximum and minimum values for each object" and "determining a set of sampling points from the maximum and minimum values" was generally vague. He further indicated that it might be helpful to revise the claim language to include the concept of calling based on the size of the primitive.

In response, Claims 1 and 10 have been amended to more closely resemble the claims recently filed in the corresponding European application.

The preamble has now been amended to clarify that the claims are directed to a method and apparatus, respectively, for "culling small objects in a system for shading 3-D computer graphics".

Claim 1, and in a similar manner, Claim 10, has now also been amended to call for the steps of:

> determining maximum and minimum values for each object in X and Y directions;
>
> for each object in the image, <u>determining a bounding box from the maximum and minimum values of the X and Y coordinates of the object</u>;
>
> determining a set of sampling points from the maximum and minimum values;
>
> <u>determining whether or not the bounding box surrounding the object covers any of the sampling points</u>;
>
> <u>culling the object if the bounding box misses all the sampling points</u>;
>
> <u>testing each sampling point against each edge of the object</u>;
>
> <u>determining from the test performed by the testing step whether or not the object covers any sampling point</u>; and
>
> adding or rejecting the object from the list in dependence on the result of the determination

(emphasis added).

The problem addressed by the claimed invention is how objects which are smaller than a certain size can be eliminated from the shading process. Such a feature is desirable as smaller objects which do not make any meaningful contribution to the final image can be culled, thereby reducing the required processing time.

The above process is accomplished by "determining maximum and minimum values for each object in x and y directions", and then "determining a bounding box from the maximum and minimum values of the x and y coordinates of the object". A set of sampling points from the object can then be determined. Then it is determined "whether or not the bounding box surrounding the object covers any of the sampling points". If the "bounding box misses all the sampling points", thereby indicating that the object is relatively small, the object is culled. If the bounding box does cover some of the sampling points, then the edges of the objects are tested to determine "whether or not the object covers any sampling point". Based on the above step, it can be determined whether the object is insignificantly small, and as such, does not make any meaningful contribution to the final image. If such is the case, the object is rejected.

In contrast to the claimed invention, Greene discloses a more traditional graphics system that neither suggests nor discloses a process of culling objects based on whether the sampling points fall within a bounding box as well as the object itself, and thus is insignificantly small. Instead, Greene discloses a system where <u>objects are culled based merely on whether an object is visible in the region</u>. Specifically, Greene teaches a calling process whereby the "near z-values are compared with far z-values computed for other objects in the region. Such comparison indicates whether an object is visible in the region". (See Greene, 5:5-12) as further emphasized, "computations within the calling stage are structured so that culling is conservative, meaning that some occluded geometry can fail to be culled as <u>visible geometry is never culled</u>". (See Greene, 11:21-24) Greene does disclose a type of culling based on bounding boxes, but unlike the claimed invention, this process of Greene is designed so that "the box is tested for occlusion, and if it is occluded, a geometry contained in the box is culled". (See Greene, 13:33-38)

Accordingly Greene neither discloses nor suggests the culling of insignificantly small objects based on "whether or not the bounding box surrounding the object covers any of the sampling points", as well as rejecting an object based on determining "whether or not the object covers any sampling point".

Similarly, Koneru fails to disclose a system or method where insignificantly small objects are culled based on whether sampling points fall within a bounding box as well as an object. Instead, Koneru deals with a method for minimizing the number of bins that are updated during binning and reducing the number of polygons to be set up in the render phase. Specifically, Koneru discloses a method of zone rendering, where a screen is subdivided into an array of zones, with each zone associated with a bin. (See Koneru, paragraph 32) "The process of assigning polygons to zones is referred to as binning. Bin refers to the abstract buffer used for each zone - where a bin will typically be realized as a series of instruction batch buffers. Binning performs the necessary computations to determine what polygons lie in what zones". (See Koneru, paragraph 36) "Per-zone instruction bins are thus used to hold polygon instructions and state-setting instructions required to render each sub-image." (See Koneru, paragraph 37) It is further noted that Koneru's zones and bins are different than a bounding box. Specifically, Koneru discloses a method for determining which bins need to be updated for a point, which includes a step wherein "when a point is received, the point parameters such as vertex values Vx and Vy and point width are determined. A bounding box is [then] created from vertex values specified." (see Koneru, paragraph 46) As then summarized, the method of Koneru allows for "fewer write backs to batch buffers during the binning phase and fewer polygons to be set up during the render phase". (See Koneru, paragraph 78)

Accordingly, Koneru neither discloses nor suggests a system or method that culls objects based on whether sampling

points fall within a bounding box, as well as an object itself, and thus considered to be insignificantly small for rendering purposes. Instead, Koneru discloses a method of binning which results in fewer write backs to batch buffers, and as such, reduces processing time.

Based on the comments above, it is believed that Claim 1 and Claim 10, along with those claims dependent therefrom, overcome all rejections based on the references of Greene and Koneru, considered individually or in combination.

IV. Conclusion

All objections and rejections having been addressed, it is respectfully submitted that the present application is in condition for allowance, and a Notice to that effect is earnestly solicited.

Respectfully submitted,

Steven Thiel

Steven R. Thiel

SRT/cc

FLYNN, THIEL, BOUTELL
& TANIS, P.C.
2026 Rambling Road
Kalamazoo, MI 49008-1631
Phone: (269) 381-1156
Fax: (269) 381-5465

Dale H. Thiel	Reg. No. 24 323
David G. Boutell	Reg. No. 25 072
Terryence F. Chapman	Reg. No. 32 549
Mark L. Maki	Reg. No. 36 589
Liane L. Churney	Reg. No. 40 694
Brian R. Tumm	Reg. No. 36 328
Steven R. Thiel	Reg. No. 53 685
Donald J. Wallace	Reg. No. 43 977
Sidney B. Williams, Jr.	Reg. No. 24 949

Encl: None

136.07/05